

APPENDIX F

Detailed Descriptions of
Hawaii's 18 Water Quality Limited Segments

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Detailed Descriptions of Hawaii’s 18 Water Quality Limited Segments

This appendix is a county by county overview of island watersheds and associated water quality health. A summary table listing the Water Quality Limited Segments and their associated pollutants is on the last page of the appendix.

CITY AND COUNTY OF HONOLULU (OAHU)

The following descriptions of the Water Quality Limited Segments (WQLSs) on Oahu are based on information contained in the 1998 State 305 (b) Report, 1997 State 303(d) list, *Hawaii’s Assessment of Nonpoint Source Pollution Water Quality Problems* (DOH 1990), *Hawaii’s Coastal Nonpoint Pollution Control Program Management Plan* (1996), and the *Water Quality Management Plan for the City and County of Honolulu* (C&C of Honolulu 1990). There are eleven WQLSs on Oahu. Since polluted runoff is mostly due to human activity, it is understandable that the most populous island has the most WQLSs.

Kahana Bay

Kahana Bay is a drowned river valley, located on the northeast coast of Windward Oahu. Its boundary is the 30-foot depth contour from Mahie Point to where the 30-foot and 18-foot contours converge. One mile of Kahana Stream is also included. The bay has a total area of 294 acres (DOH 1990, p. V-7). The Kahana State Park, with an area of 7.96 square miles, covers almost the entire drainage area of 8.33 square miles. The offshore boundary of the segment extends from Mahie Point northward to the 30-foot depth contour, then westward along the 30-foot contour following northward until the 30-foot and 18-foot contours converge to meet the shoreline.

Kahana Bay is a natural embayment, used for swimming, boating, and other water recreational sports (C&C of Honolulu 1990, p. 8-16). It is an example of a waterbody where natural events have a greater influence on water quality than human activities. The entire valley is a State Park. It is essentially a pristine area, with only limited development at the lower end of the valley (DOH 1990, p. V-7).

There are no point source discharges into the bay. However there are some residential cesspools. The resident population is estimated to be 130 people living in 30 households. The existing cesspools will be eliminated as homes are refurbished. Public convenience stations are located in the State Park and the City Beach Park and discharge wastes into cesspools. Sediments and nutrients are transported into the bay by Kahana Stream and overland routes (C&C of Honolulu 1990, p. 8-18).

Total freshwater runoff into the bay is estimated at 30 million gallons per day(mgd). Of the eight parameters tested by the DOH at its monitoring station, five parameters have values exceeding the maximum criteria allowed for that parameter. Major violations have been found for ammonia nitrogen, total nitrogen, total phosphorus, turbidity, and chlorophyll (C&C of Honolulu 1990, p. 816). The high levels of nitrogen and phosphorus are primarily due to the lush vegetative growth in the valley and the stream estuary.

Kaneohe Bay

Kaneohe Bay is the largest embayment in the State of Hawaii with a surface area of 18 square miles. It is 7.9 miles long and 2.6 miles wide and has a volume of 70,263 million gallons. Mean depth is 27 feet. The land area of the basin is 40 square miles and average stream flows are 64 mgd. Subareas of Kaneohe Bay include Heeia Boat Harbor, Kaneohe Yacht Club, and Kaneohe Marine Corps Air Station Harbor. The water quality limited segment boundary extends northwestward from Pyramid Rock along the 18-foot depth contour to Chinaman's Hat, and westward to Kualoa Point (C&C of Honolulu 1990, p. 8-19).

Historically, Kaneohe Bay teemed with marine life. Major problems arose as a result of the introduction of hoofed animals, and more significantly, because of the extensive farming of pineapple prior to 1940. Pineapple cultivation caused extensive sedimentation of the bay. Also the bay itself was severely stressed by a massive (about 11 million cubic yards) coral reef dredging between 1939 and 1942 as part of seaplane landing area construction. Most of this material was used for landfill in the bay, primarily at what is now known as Marine Corps Base Hawaii. The bay was again stressed by the construction of a sewage disposal outfall in the center of the south bay that introduced unnaturally large amounts of nutrients. After these stresses came urbanization in the late 1950s through the 1970s. One major problem was uncontrolled grading which exacerbated the stresses of erosion and sedimentation from pineapple cultivation, and brought new sediments to the bay. It is now well documented that major inflows of freshwater from high intensity rainfall can build up in the bay, creating a lens which can reach up to 5 feet in depth floating on the surface of the bay. Runoff problems are compounded by channelization in the watershed, the paving over of formerly permeable surfaces in the basin, and the filling and loss of wetlands and fishponds along the shores, which acted in the past to detain stormwater runoff.

The bay has shown improvement in water quality over the past two decades, and today is somewhat stabilized. Elimination of all municipal effluent discharges into the bay has been accomplished. Municipal sewers serve most of Kaneohe, Ahuimanu, and Kahaluu, but the rural areas from Ahuimanu to Waikane are still being served by household cesspools. The estimated number of cesspools in the drainage basin prior to Kahaluu’s sewer development in 1995 was 2,880, serving a population of 10, 160 people. Since Kahaluu has been sewered, there are approximately 270 remaining cesspools in the Waiahole and Waikane areas (C&C of Honolulu 1990, p. 8-21).

There has been a dramatic decline in phosphorus and turbidity since 1979, when sewage discharge was diverted from the bay (C&C of Honolulu 1990, p. 7-6). The termination of sewage discharges and better management of construction activities has resulted in improved survival of some species of coral and other organisms. However, urban runoff continues to be a major source of pollution to the bay (DOH 1990, p. V-10). The water quality parameters frequently violated are turbidity and nitrogen during winter storms. The major sources affecting turbidity and suspended solids parameters are natural runoff, urban stormwater, and small farming. The same sources plus winter storms affect the nitrogen parameters. Direct groundwater seepage into the bay is estimated to be 60 mgd and storm runoff, 40 mgd (C&C of Honolulu 1990, p. 8-19).

Runoff from the numerous streams during winter storms conveys large quantities of silt and other material which settle into the bay. The entire bay is affected by suspended particles, especially in the southern section of the bay where the residence time with respect to the ocean has been estimated to be almost 24 days. Estimates of sediment loading into Kaneohe Bay from storm runoff range from 33,000 to 131,000 tons per year (C&C of Honolulu 1990, p. 8-22).

Ala Wai Canal

The Ala Wai Canal is a manmade canal extending southeast by northwest from Kapahulu Avenue to Ala Moana Park. The Ala Wai Boat Harbor is located at the mouth of the canal. The canal was completed in 1929 to reclaim marsh lands fed by the perennial Manoa and Palolo streams and to control mosquitoes. The marsh, located in what is now the McCully-Kapiolani District, consisted of taro patches, rice paddies, and duck and fish ponds. The canal was originally dredged to Kewalo Basin, and then out to the sea. Later in the 1950s, the present channel at the Ala Wai Boat Harbor was dredged and the channel along Ala Moana Park was filled in (C&C of Honolulu 1990, P. 8-22).

The canal is 9,770 feet long. Its width varies from 160 to 260 feet and depth from 15.0 feet to -6.0 feet. The area of the canal and boat harbor is 126 acres. The water quality limited segment includes the entire length of the canal, the boat harbor, and the boat channel to the 30-foot depth contour. The harbor is recognized as an embayment. A portion of the canal is an estuary (C&C of Honolulu 1990, p. 8-22).

The major contributions come from erosion in the forest reserve areas at the upper end of Manoa Valley; groundwater inflow; storm runoff from residential and commercial developments; direct runoff from Ala Wai Field, Park, and Golf Course; dumping of household and yard wastes into the Manoa and Palolo streams; and two minor point source discharges, washwater from the Ala Wai Marine Railway dry dock operation (only under emergency conditions), and 2.60 mgd discharge of warm water from the air conditioning system of the Yacht Harbor Condominium. The entire drainage area is served by municipal sewers except for the Crater Road area of West Kaimuki and Makiki-Puowaina. These areas have household cesspools and serve an estimated population of 1,341 people (C&C of Honolulu 1990, p. 8-24).

The Ala Wai serves as a sedimentation basin for its tributary streams and receives storm runoff from Manoa, Palolo, Makiki, Waikiki and other areas. The average stream flow into the canal is estimated to be between 20-30 mgd. Sediments are deposited in the Ala Wai Canal because the low flow velocity in the canal is less than the settling velocity of the sediment. Large quantities of sediment are believed to be generated in the watershed areas by natural erosion process. The canal was dredged by the City in 1966 and again by the State in the late 1970s (C&C of Honolulu 1990, p. 8-24). From the results of present and past studies of sediments in the canal, it is estimated that the rate of siltation has been relatively consistent at 9,000 to 11,000 cubic yards per year (Edward K. Noda & Associates 1992b, p. 4). Without the canal, much of this sediment would be released into coastal waters.

As the collecting point for the Makiki, Manoa, Palolo, and Kapahulu watersheds, the canal accumulates sediments, nutrients, some heavy metal contaminants, and solid waste trash. Consequently, water in the canal is discolored by phytoplankton growth, suspended sediments, and visually objectionable trash. In addition, some incidences of bacterial infections have been reported (Edward K. Noda & Associates 1993, p. 2-6). Water circulation from the point where the Manoa Stream meets the canal to the end of the canal near Kapahulu is poor. Floating debris collects under the makai side of the McCully Street Bridge, creating an unsightly mess.

Kewalo Basin

Kewalo Basin is a manmade harbor, approximately 78 acres in area. Constructed by the U.S. Navy in 1945, it is home port for the local tuna fleet, chartered sport fishing boats, and excursion craft serving the tourist industry. The basin is surrounded by shopping centers, a major highway, and the light industrial areas, commercial shops, and restaurants of Kakaako and Kewalo, and park space at Kakaako and Ala Moana. Kewalo Basin is classified as an embayment. The water quality segment encompasses the entire basin and channel out to the 30-foot depth contour (C&C of Honolulu 1990, pp. 8-25 and 8-26).

Low levels of dissolved oxygen and unsatisfactory pH levels have been measured at the outlet of the Ala Moana Park drains to the northeast sector of the basin. It is suspected that allowable limits for the nitrogen, phosphorus, and turbidity parameters are exceeded during periods of heavy storm runoff. Circulation of water in the basin is hindered by its design. As a result, the urban pollutants that collect in the basin remain concentrated for extended periods (DOH 1990, pp. V11 and V- 12).

The primary sources of pollutants entering Kewalo Basin are the drains collecting urban runoff from commercial, industrial, and residential sectors of Honolulu. There are seven drains including three that serve major facilities: Ala Moana Park drain (canal), Ward Avenue drain, and Kakaako drain. About one half of the peak discharge from Ala Moana Park canal enters Kewalo Basin, the other half drains into Ala Wai Boat Harbor (C&C of Honolulu 1990, p. 8-26). Street debris, oil, chemicals, nutrients, and heavy metals are transported by urban runoff into

Kewalo Basin. There are no discharges of any sediments from streams since the drainage area is entirely urbanized (C&C of Honolulu 1990, p. 8-27).

Keehi Lagoon

Keehi Lagoon, with an area of 1,116 acres, is the largest lagoon in the State. It is located in a heavily industrialized area between Kapalama-Sand Island and Honolulu International Airport in the east-west direction. The Mapunapuna and Shafter Flats industrial parks and the Middle Street interchange of H-1 are located to the north. Keehi Boat Harbor and Keehi Marine Drydock are located along the Kapalama shoreline and serve boating and sailing interests. Kalihi Stream from the northeast and Moanalua Stream from the northwest meet at the head of the lagoon at Keehi Lagoon Beach Park. Keehi Lagoon is classified as an embayment; Keehi Harbor and Keehi Drydock Boat Harbor are classified as shallow draft recreational harbors. The water quality segment encompasses the entire lagoon to the 30-foot depth contour (C&C of Honolulu 1990, p. 8-27).

The lagoon is used intensely for bait fishing, crabbing, paddling, and other water contact sports. Boating activities are especially heavy during weekends and holidays. A boat washing facility is part of the boat harbor (C&C of Honolulu 1990, p. 8-27). Although circulation in Keehi Lagoon is good, it regularly experiences violations of water quality parameters for phosphorus and turbidity. Currents may transport polluted waters from Honolulu Harbor into the lagoon and recirculate suspended matter within it (DOH 1990, p. V-11). Other pollutant sources are sediments deposited in the lagoon by Moanalua and Kalihi streams; storm runoff from industrial areas of Mapunapuna, Shafter Flats, Kapalama, and Kalihi Kai; and the resuspension of settled sediments in shoals by boating activities (C&C of Honolulu 1990, pp. 8-27 and 8-28).

The elimination of the municipal and U.S. Army raw sewage discharges in nearshore waters off Sand Island and the airport outfall off Ahua Point have greatly improved water quality in the lagoon. The number of cesspools receiving commercial and industrial wastes in the Mapunapuna and Kapalama areas is not known. Considering the number of lots in the tracts, the number of cesspools could be as many as 150.

Nutrients, plant cuttings, and sediment loads are discharged in Keehi Lagoon by Kalihi and Moanalua streams. In residential areas, trash, plant cuttings, and yard debris are frequently dumped in the stream channel and reach the lagoon. Policing of illegal dumping is difficult because it can occur at any time (C&C of Honolulu 1990, p. 8-28).

Honolulu Harbor

Honolulu Harbor is the largest commercial deep draft harbor in the State. The harbor is crescent shaped, with a water surface area of 537 acres. It is about 2 miles long and from 600 to 2,900 feet wide. Coral reefs and Sand Island, a 500-acre manmade island, protect the harbor from the open ocean. Goods and freight processed at the harbor cover the entire spectrum, from

pineapple and cattle to automobiles and petroleum products. The harbor handles over 11 million tons of cargo annually (C&C of Honolulu 1990, p. 8-30).

Honolulu Harbor is classified as an embayment. The water quality segment encompasses the entire harbor from Keehi Lagoon to the Fort Armstrong main channel entrance to the 30-foot depth contour (C&C of Honolulu 1990, p. 8-30). Both Nuuanu and Kapalama streams discharge into the harbor. Nuuanu Stream extends from Pier 15 to its watershed area in the Koolau Range. The drainage area of 8.4 square miles consists of industrial, commercial, and residential developments. Kapalama is an interrupted stream with a drainage area of 2.6 square miles (C&C of Honolulu 1990, p. 8-31).

The most frequently violated parameters are total nitrogen, total phosphorus, turbidity, dissolved oxygen, and pH. Prior to about 1972, the pineapple canneries and Gasco discharged 10.3 mgd of industrial wastes into Kapalama Canal and Honolulu Harbor. The BOD load was equivalent to raw sewage discharge from 150,000 people. Now, the wasteload into Kapalama Canal has been limited to the discharge of thermal water.

Studies of the harbor indicate that nitrogen, phosphorus, and turbidity levels in the water regularly exceed State water quality standards. Significant levels of copper, zinc, chromium, nickel, lead, chlordane, and dieldrin have been identified in DOH sampling (DOH 1990, p. V-6). Pollutants enter the harbor mainly from nonpoint sources. Kapalama Stream (canal) discharges into Kapalama Basin at Pier 39, and the larger Nuuanu Stream enters the main basin at Pier 15, upstream of Pier 11. Storm drain outlets discharge into the harbor throughout its the periphery (C&C of Honolulu 1990, p. 8-31).

Most of the sediments deposited in Honolulu Harbor come from Nuuanu and Kapalama streams. No data are available, but the U.S. Army Corps of Engineers (USACOE) estimated that 50,000 cubic yards of sediments are discharged in the harbor each year from all sources. According to USACOE, the sediments are composed of high percentages of land derived silty clays and a small percentage of sand. The harbor is dredged at about five year intervals (C&C of Honolulu 1990, p. 8-32).

Pearl Harbor

Pearl Harbor is the State's largest estuary. It is nearly completely surrounded by federal military installations. The U.S. Navy installation with its associated shipyard, maintenance supply center, public works center, and ammunition depot is located around the harbor. It is headquarters for CINCPAC and the 14th Naval District. The harbor consists of East Loch, Middle Loch, West Loch, Southeast Loch, and Ford Island, and has a water surface area of about 8 square miles. More than 12 miles of docks and four drydocks are available for ship repairs. The US Air Force’s Hickam Air Force Base borders a small portion of Pearl Harbor's eastern shoreline.

The Water Limited Quality Segment includes the entire harbor and the mouths of perennial streams discharging into the harbor. The offshore boundary of the segment extends to the 30-foot depth contour between the Reef Runway to Oneula Beach (C&C of Honolulu 1990, p. 8-32).

As a result of its geologic origin, Pearl Harbor has been the "sink" of the southern coastal plain of Oahu. Its three lochs represent the drowned valleys of three major stream systems. These "valleys" have been altered in shape by marine erosion and sediment. The most drastic changes to the harbor are those which occurred during and after World War II (DOH 1990, p. V-14).

Five streams -- Halawa, Aiea, Kalauao, Waimalu, and Pearl City -- are tributary to East Loch. Waiawa enters Middle Loch, and Waikele and Honouliuli drain into West Loch. The drainage area for the lochs are 23.7, 26.4, and 60 square miles, respectively, for a total of 111 square miles (C&C of Honolulu 1990, p. 8-32).

Beneficial uses identified for Pearl Harbor include bait fish and shellfish propagation in West and East Lochs, shipping, navigation, industrial water in East Loch, and water fowl habitat in Middle and West Lochs.

There are five point source discharges within the harbor operated by the U.S. Navy and one (Fort Kamehameha STP) discharging at the main ship channel. The nonmilitary point source, Waiau Power Plant, discharges thermal water. Municipal sewers serve most of the urban areas between Aiea-Halawa and Waipahu. The number of household cesspools in Aiea-Waiiau and Waipahu is estimated to be 400 (C&C of Honolulu 1990, p. 8-36).

Water quality parameters that are frequently violated in Pearl Harbor include nitrogen, phosphorus, turbidity, fecal coliform, temperature, and chlorophyll a.

Kaiaka-Waialua Bay

This WQLS includes two adjacent waterbodies on the North Shore of Oahu. Kaiaka Bay is classified as an embayment, while the much broader Waialua Bay is classified as marine waters. Haleiwa Boat Harbor, located at the original mouth of the Anahulu River, is also an embayment. The WQLS's boundary extends westerly from Puaena Point to the 60-foot depth, then along the 60-foot depth contour towards Kaena Point past Kaiaka Bay, then southwest toward the shore at Kaimana Place.

Both bays receive drainage from major streams. The Poamoho and Kaukonahua streams are tributaries of Kiiiki Stream that flows into Kaiaka Bay together with Paukauila Stream that includes Helemano and Opaepa streams. The area of the drainage basin is 79.8 square miles and extends eastward to the Koolau mountain range and southward to the Waianae mountain range (C&C of Honolulu 1990, p. 8-39).

Leakage of fresh water through caprock into Opaepa, Helemano, Poamoho, and Kaukonahua streams and the bay is estimated to be 7.05 mgd. Peak storm flows (100 year storm) estimated for Kiikii Stream are 39,000 cfs; and for Paukaula Stream, 18,700 cfs. As much as 70% of the streams are diverted for agriculture. Anahulu River and its tributaries (Kawaiiki and Kawainui streams) discharge into Waialua Bay. At Waialua Bay, Anahulu River has a drainage area of 16.0 square miles and a 100-year peak discharge of 16,200 cfs.

Data collected at the DOH monitoring station indicate that the maximum allowable levels of most parameters are exceeded except for dissolved oxygen. Most noteworthy are total phosphorus, nitrate and nitrite nitrogen, chlorophyll a, and turbidity (C&C of Honolulu 1990, pp. 8-39 and 8-41). The major sources of pollutants discharging into the embayments are sediments from the drainage basins, household cesspools, injection wells from treatment plants, and a point source discharge of thermal water. There are 13 private STPs and one municipal wastewater treatment plant (P) in the Waialua and Haleiwa communities. The effluents from these plants are discharged into seepage pits or injection wells.

There are 2,312 household cesspools in the Waialua and Haleiwa area, serving a population of 7,232 people. The estimated 0.578 mgd discharge into the groundwater eventually reaches the coastal waters.

MAUI COUNTY:

The following descriptions of the Water Quality Limited Segments of Maui County are based on information contained in the 1998 State 305 (b) Report, 1997 State 303(d) list, *Hawaii’s Assessment of Nonpoint Source Pollution Water Quality Problems* (DOH 1990), *Hawaii’s Coastal Nonpoint Pollution Control Program Management Plan* (1996), supplemented by information from the *Water Quality Management Plan for the County of Maui* prepared jointly by DOH and the County of Maui (DOH 1993c). There are three WQLSs in Maui County, two on the island of Maui and one on Molokai. The three WQLSs and their watersheds are described below.

Kahului Bay

Kahului Bay is located on the north coast of the Island of Maui between the slopes of two volcanoes, Haleakala and West Maui. It covers an area of 242 acres and is bounded by the breakwaters which extend from the west and east shores at about right angles to each other. Kahului Harbor is located on the southern portion of the Bay.

Drainage into Kahului Bay is largely in the form of runoff from the urban centers of Wailuku and Kahului. In addition, ship and barge traffic, the Kahului airport, lands used for sugarcane cultivation, and east portions of the West Maui mountains (forest land) contribute pollutants. No streams or springs enter Kahului Bay.

State monitoring of Kahului Bay indicates that water quality standards for nitrogen, phosphorus, and turbidity are regularly exceeded. Incidents of bacterial contamination which result from cruise ship spills and storm drain outputs have been reported. The waters of the bay are generally poor in quality. The powerful long shore current, which sweeps around the north tip of East Maui, likely affects the residence time of pollution in Kahului Bay. Waters at the mouth of the harbor are generally turbid, and underwater visibility is generally poor due to strong winds that keep waters turbulent and murky (DOH 1990, p. V-8).

A number of activities occur in Kahului Bay. Kahului Harbor is the Island's main port. An estimated 98.9% of all goods coming into Maui are transported through Kahului Harbor. Harbor activities include ship operation and maintenance, oil handling and bunkering, warehousing, trucking, storage, stevedoring, marine repair, and limited drydocking (DOH 1990, p. V-9). In addition, a cluster of hotels, beaches, the Kahului Breakwater Park, and a public boat ramp border the Bay. The bay's shoreline access is excellent. People fish along the piers, breakwaters, and the coast between the harbor and Nehe Point. Large surf breaks in the harbor during periods of North Pacific swells.

West Maui

The West Maui area was designated as a WQLS in 1992 primarily because of the algal blooms that have been occurring there and which are suspected to be caused by excessive nutrients from runoff. The near shore coastal waters of Kihei are also included in this

designation. Violations in this area are all for nitrogen parameters: total Kjeldahl nitrogen, nitrate-nitrite N, and ammonia nitrogen. Federal funds obtained by EPA and NOAA are being used to support a watershed coordinator; additional applied research projects have been conducted on the link between land use activities and surface and ground water quality. DOH intends to incorporate the results from these projects into nutrient/sediment watershed management plans for West Maui and similar sensitive coastal areas throughout the State (DOH 1993c, p. VII-14). This information will also be used by EPA and DOH to establish TMDLs for this WQLS.

South Molokai

The South Molokai segment is bounded by the 18-foot depth contour from Laau Point eastward to Honouliwai, just east of Waialua. Many streams within this area, mostly the eastern portion, are perennial in their upper reaches and intermittent or nonexistent at the coastline. During heavy rains, however, these streams will fill with water, overflow their banks, and flood the entire southern coastline with turbid runoff. Runoff transported by these streams are generated from abandoned pineapple fields, cropland, pastures, a State highway system, a network of dirt roads, feral animal activity, damaged areas from range fires and the town of Kaunakakai. Of particular concern are the dirt roads, fire damaged areas, and poorly managed pasture land.

On Molokai, drought conditions and incessant strong winds reduce soil moisture, preventing the growth of adequate cover. When rains do occur, they are often intense and heavy, creating immense amounts of runoff that can transport sediments and pollutants. Flows into South Molokai are heaviest into the Palaau coastal plains located just west of Kaunakakai (DOH 1990, p. V-15).

The waters of South Molokai are classified as open coastal waters. State monitoring of South Molokai shows significant violations of water quality standards for suspended solids and nutrients. Suspended solids have been noted to exceed the standard by 100 times.

Mudflats predominate on the island's south coast where there were once a large number of fishponds. Valued water activities along the southern coast include fishpond restoration for commercial and subsistence use, support of an important wildlife area, and enhancement of park facilities. Parks and recreational facilities on Molokai's south shore include: Kakahaia National Wildlife Refuge, One Alii Beach Parks 1 & 2, and Malama Park.

KAUAI COUNTY:

The following descriptions of the Water Quality Limited Segments in Kauai County are based on information contained in the 1998 State 305 (b) Report, 1997 State 303(d) list, *Hawaii’s Assessment of Nonpoint Source Pollution Water Quality Problems* (DOH 1990), *Hawaii’s Coastal Nonpoint Pollution Control Program Management Plan* (1996), supplemented by information from the *Water Quality Management Plan for the County of Kauai* prepared jointly by DOH and the County of Kauai (DOH 1993b). There are three WQLSs on Kauai. A description of the segments and their drainage areas follows.

Nawiliwili Harbor

Nawiliwili Harbor and its adjacent bay is located on the southeast coast of Kauai, two miles from Lihue. It is a well-developed embayment of 333 acres, bounded by an imaginary line from Kukii Point to the breakwater. It is formed by the confluence of three streams, Huleia, Puali, and Nawiliwili. Huleia is the largest stream, arising from the Waialeale-Kawaikini mountains in central Kauai. It flows through forest, agricultural, pasture, and other lands. The lower part of Huleia Stream widens into a significant estuary. Although the Nawiliwili and Puali streams drain flatter and less erosive lands they also contribute nonpoint pollutants. A rock quarry located on the Nawiliwili Stream is a major contributor of sediment to the bay (DOH 1993b, p. V-12).

Although there are no longer any point source discharges into Nawiliwili Bay, State monitoring shows that water quality standards for nitrogen and turbidity are regularly exceeded. These levels are suspected to be the product of vegetative growth along the river and seasonal input from storm water sources. Dense growths of hau and American (red) mangrove decompose and introduce considerable amounts of organic material into the bay. In addition, heavy rains transport silt and nutrients from sugarcane land into the bay and give it, at times, a brown color (DOH 1993b, p. V-13).

Nawiliwili Harbor supports a deep draft commercial harbor and a small boat harbor with charter fishing operations. The bottom consists of fine sand and silt. Depths range from 70 to 100 feet; periodic dredging is required to maintain navigable depths in the harbor (DOH 1993b, p. V-13). Recreational activities include fishing and crabbing in the bay and adjoining Huleia River, and surfing and canoe paddling in the area fronting Kalapaki Beach on the north shore of the bay (DOH 1993b, p. V-14).

Hanapepe Bay

Hanapepe Bay is located on the southwest corner of Kauai, between Hanapepe and Port Allen. The boundary of the Hanapepe Bay segment extends along the 1,000 foot long breakwater on the eastern shore and the 30-foot depth contour to a point south of Pualo Point, enclosing 297 acres of water surface (DOH 1993b, p. V-3).

The Hanapepe River begins in forest uplands and travels through pasture and range land, coffee lands, sugar cane lands, and the small towns of 'Eleele, Port Allen, and Hanapepe. Hydrologic modifications have greatly affected the bay. Erosion of the western end of the one-

half-mile-long beach at the head of the bay has been accelerated because of construction of a breakwater (DOH 1993b, p.V-3).

State water monitoring records indicate that the waters of the bay regularly exceed State standards for turbidity. Discoloration of the bay as a result of flood flow discharges is a common occurrence. However, the waters generally clear rapidly.

An important Hawaiian salt production area and salt marshes with great wildlife value are located on the east banks of the bay. Some commercial activity occurs at Port Allen in Hanapepe Bay but for the most part, activity in the bay is recreational. Activities include swimming, pole and line fishing, and small boating (DOH 1993b, p. V-4).

Waimea Bay

The Waimea Bay WQLS is located on the southeast coast of Kauai. It is bounded by the 18-foot contour from Oomano Point to Koki Point and includes the Waimea River and Kiki a Ola Boat Harbor. It comprises 1,214 acres. Two rivers flow into the bay, the Waimea and the Makaweli.

The watershed has conservation lands at its headwaters and agriculture land use dominates below. Currently, crops are grown for commercial seeding operations and agricultural research. Historically, sugar mills discharged cane trash and wastewater into the coastal waters of southern Kauai. These discharges contained silt that were carried by ocean currents to Waimea Bay. Bagasse (cane waste) is now used as a fuel source and the mill wastewater is returned to sugar cane fields for irrigation. The only remaining discharges are irrigation tailwater (DOH 1993b, p. V-17). There are small urban runoff issues with the town of Waimea located within this water quality limited segment. Sediment is the major water quality issue here.

There is a boat launching ramp at Kiki a Ola light draft vessel harbor. Uses of Waimea Bay include pole and line fishing, throw netting, board surfing, canoe paddling, limu gathering, gill netting, and torching (DOH 1993b, p. V-18).

HAWAII COUNTY:

The following description of the Water Quality Limited Segment in Hawaii County is based on information contained in the 1998 State 305 (b) Report, 1997 State 303(d) list, *Hawaii’s Assessment of Nonpoint Source Pollution Water Quality Problems* (DOH 1990), *Hawaii’s Coastal Nonpoint Pollution Control Program Management Plan* (1996), supplemented by information from the *Water Quality Management Plan for the County of Hawaii* prepared jointly by the Hawaii State Department of Health and the County of Hawaii (DOH 1993a). Hilo Bay is the only WQLS on Hawaii.

Hilo Bay

Hilo Bay is located on the northeast coast of the Island of Hawaii. It is bounded by the 30-foot depth contour, from the tip of the 10,079-foot long breakwater to Paukaa Point, and covers an area of 1,788 acres. Included in the segment is the Waiakea Pond and Wailoa River (DOH 1990, p. V-4).

Five natural discharges enter into the Hilo Bay segment: Wailoa River, Wailuku River, Pukihae Stream, Pohakaunanaka (intermittent stream), and Maili Stream. These rivers and their tributaries originate on the slopes of Mauna Kea and Mauna Loa, and drain forests, pasture and range land, agricultural fields, and urban areas. In the higher elevations, eucalyptus trees are raised. Cattle graze the Puu Oo area above the forest reserve and the mauka fringe of the city of Hilo. Sugar, the principal crop of the island, is grown in the Hilo Bay watershed in the rural areas north of Hilo along the Belt Highway. Major agricultural changes have occurred in recent times with the closures of sugar plantations. As an example, there is the conversion of 8,000 acres of sugar cane land to macadamia nut orchard. Commercial raising of trees, mostly eucalyptus, is expanding in this area. Specialty crops such as ginger are grown nearby. Cattle, hogs, poultry, vegetables, flowers, and landscaping plants are also grown in the area surrounding Hilo. Urban runoff come from sources such as stream channelization, Hilo's parks, business and residential zones, infrastructure, and harbor.

The Wailuku (300 mgd) and Wailoa rivers (100 mgd to 300 mgd), compose the major discharges of water and sediment to the bay. Large surface and subsurface flows enter the bay and form a fresh water layer on the surface of the bay. The vertical stratification, which is maintained by the prevailing shoreward trade winds of the area, prolongs the residence time of water in the bay and encourages the growth of phytoplankton in its upper fresh water layer. In addition, the slow seaward movement of the bay's lower waters are generally insufficient to flush out suspended silts from the bay. Silt and mud that accumulate contribute to the bay's turbidity (DOH 1990, p. V5).

Nutrient-rich waters, which enter as both surface and subsurface flows, increase the growth of microscopic life and algae contributing to the turbidity of the bay. Nutrient-rich flows include the surface flows of the Wailoa River as well as subsurface flows from sources near Reeds Bay, Coconut Island, and the Keaukaha area. Subsurface flows contribute flow volumes as high as 200 mgd.

State monitoring of water for Hilo Bay shows frequent violations of water quality standards for nitrogen, phosphorus, and turbidity. A study found exceptionally high levels of arsenic in sediments in Hilo Bay and, in particular, from Waiakea Pond. Other contaminants found in Hilo Bay included lead, zinc, chromium, chlordane residues, and PCBs (DOH 1990, p. V-5). Despite these high levels, however, there is no indication of any health hazard.

The high levels of arsenic in the bay and in Waiakea Pond resulted from waste discharges containing arsenic trioxide, a compound used in a kenec manufacturing plant to treat fiber boards to prevent termite damage.

Hilo Bay is also affected by seepage from cesspools. A study confirmed DOH monitoring results and notes that Hilo Bay, its estuaries and adjacent marine waters are subject to chronic nonpoint source sewage pollution. The data in the study report indicate that high bacterial counts are not the result of sewage treatment plant failures but rather sewage contained in freshwater runoff, with the ultimate source commercial and residential cesspools [Dudley and Hallacher (n.d.), pp. 32-341.

In spite of its water quality problems, Hilo Bay is an important wildlife and fishery area. Hilo Bay, in addition, is highly visible to residents and tourists and supports a fair amount of recreational boating (DOH 1990, p. V-6

TABLE F-1

HAWAII’S PRIORITY WATERSHEDS BASED ON WATER QUALITY LIMITED SEGMENTS

Watershed & Island	County	Specific Pollutants
Hilo Bay, Hawaii	Hawaii	turbidity
Ala Wai Canal, Oahu	Honolulu	pesticides, metals, lead, nutrients, nitrogen, phosphorous, siltation, pathogens, turbidity
Honolulu Harbor, Oahu	Honolulu	nutrients, siltation, turbidity
Kahana Bay, Oahu	Honolulu	siltation, suspended solids
Kaiaka-Waialua Bays, Oahu	Honolulu	turbidity
Keehi Lagoon, Oahu	Honolulu	siltation, suspended solids, turbidity
Kewalo Basin, Oahu	Honolulu	nitrogen
Koolaupoko, Oahu: -Kapaa Stream -Kawa Stream -Waimanalo Stream	Honolulu	-nutrients, siltation, pathogens -nutrients, siltation, pathogens, turbidity, exotic species -nutrients, siltation, other habitat alterations, pathogens, exotic species
Pearl Harbor, Oahu	Honolulu	nutrients, siltation, turbidity, organic chemicals
Hanapepe Bay, Kauai	Kauai	nutrients
Nawiliwili Bay, Kauai	Kauai	turbidity, metals
Kahului Bay, Maui	Maui	nutrients, pathogens
South Molokai, Molokai	Maui	nutrients, suspended solids, turbidity
West Maui, Maui	Maui	nutrients, suspended solids, turbidity, pathogens

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